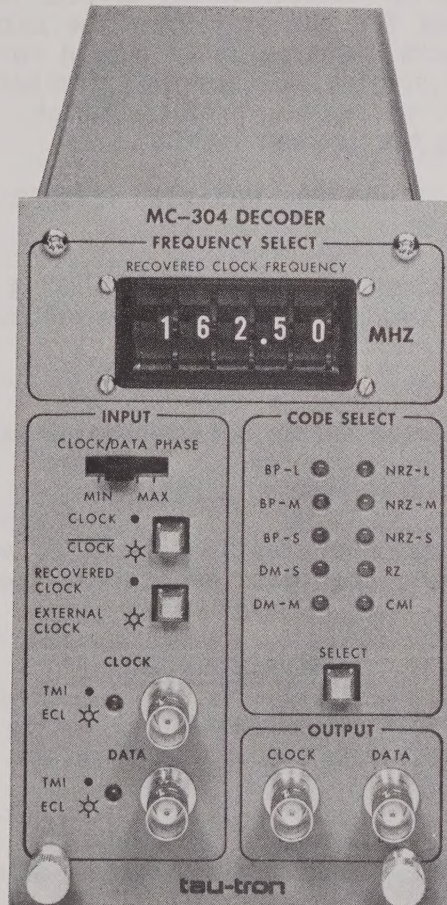


tau-tron
A UNIT OF
GENERAL SIGNAL





MC-304

DECODER OPERATION MANUAL

FORM 0233-0882A

WARRANTY

All Tau-tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-tron manufactured products. The warranty period for OEM products sold by Tau-tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction; see Repair Returns below.

SHIPPING DAMAGE

If any signs of damage are noted on the outside of the carton, request that the carrier's agent be present during unpacking. If external damage is found on the instrument, follow Repair Returns procedure below.

Check the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Returns procedure below.

REPAIR RETURNS

For mechanical damage or electrical malfunctions, notify Tau-tron immediately. If the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Department, (617) 692-5100, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.
2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.
3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb; 159 kg) and shock-absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.
4. Send to: Tau-tron Inc.
10 Lyberty Way
Westford, MA 01886
Attn: Customer Service

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1. SCOPE

This operation manual has been prepared primarily for the purpose of assisting operations personnel in providing effective operation and routine maintenance of the MC-304 Decoder.

This manual includes procedures for removal and installation, operation, theory, and routine maintenance.

All information, illustrations and specifications contained in this manual are based on the latest product information available at time of publication. If your model differs from the specifications contained in this manual, consult the factory for information.

The right is reserved to make changes in specifications and methods at any time without notice.

2. DESCRIPTION

The MC-304 Decoder accepts as inputs high-speed data in BiPhase (level, mark or space), NRZ (level, mark, or space), Delay Modulation (mark or space), RZ or CMI formats and a high-speed clock. The output data stream is in NRZ-L format. The clock output can be selected as either front-panel input clock or recovered clock via the internal clock recovery system.

The module is designed as a companion unit to the MC-303 Binary Encoder module which accepts clock and NRZ-L input data and outputs any of the above listed binary formats along with a clock at the input clock frequency.

The frequency range of both units is 1 kHz to 285 MHz in NRZ and RZ formats, and 1 kHz to 145 MHz in BiPhase, Delay Modulation, and CMI formats. The clock recovery system in the MC-304 will recover clock from 1 MHz to 285 MHz. The recovered clock frequency is selected via thumbwheel switches located on the front panel.

The clock and data input levels are selectable; with either 1V into 50 ohms to ground or 1V into 50 ohms to -2V.

The quarter-size module is designed for use in Tau-Tron Modular Instrumentation (TMI) and requires a mainframe for power and cooling.

3. SPECIFICATIONS

3.1 Inputs

3.1.1 CLOCK

1V $\pm$ 200 mV into 50 ohms-to-ground or 1V into 50 ohms to -2V, selected by internal slide switch.

3.1.2 DATA

1V $\pm$ 200 mV into 50 ohms-to-ground or 1V into 50 ohms to -2V, selected by internal slide switch. Binary formats accepted are NRZ-L, M and S; BiPhase-L, M, S; DM-M and S; RZ and CMI.

3.1.3 FREQUENCY RANGE

Decoder: 1 kHz to 325 MHz for NRZ and RZ formats. 1 kHz to 162.5 MHz for BiPhase, Delay Modulation and CMI formats.
Clock Recovery: 1 MHz to 325 MHz.

3.2 Outputs

3.2.1 CLOCK

1V $\pm$ 200 mV into 50 ohms to -2V, 50 $\pm$ 10% duty cycle.

3.2.2 DATA

1V $\pm$ 200 mV into 50 ohms to -2V. The format is NRZ-L.

3.2.3 RISE/FALL TIME-CLOCK AND DATA

1.0 ns. max., 500 ps typical (10%-90%) $\pm$ 7% max. distortion when driving a 50 ohm DC load.

3.2.4 CLOCK/DATA SKEW

The relationship between the rising edge of the clock and the data is $\emptyset \pm 500$ ps.

3.3 Mechanical

TMI quarter-size module. DIMENSIONS: 6.375 in. high x 4 in. wide x 11 in. deep. WEIGHT: 3 lb net, 5 lb shipping.

3.4 Power

120, 220, or 240V $\pm$ 10%, 48 to 66 Hz, 240 VA supplied by MF-5 Mainframe.

3.5 Accessories Supplied

Instruction Manual

3.6 Options

OP-02 IEEE-488 Interface (GPIB)

For remote control of code selection and input/recovered clock selection. Requires MF-5 with OP-02 (GPIB) installed.

4. INSTALLATION

This section provides recommendations for installing the MC-304. It covers MF-5 Mainframe site requirements and module insertion/removal of the MC-304 in the MF-5 Mainframe as shown in Figure 4-1.

4.1 SITE REQUIREMENTS

A typical MF-5 Mainframe with MC-304 should be set up in an environment free from extremes in humidity, temperature and vibration (refer to the table below). As a rule, adequate lighting in addition to front and rear access to the unit should be provided. Similarly, the user should avoid placing the unit in areas where high concentrations of heat from associated equipment are produced. In addition, the unit should not be set up in areas where cable congestion could become quite prevalent.

AC Power	120, 220 or 240V $\pm 10\%$, 48 to 66 Hz
Temperature	32°F to 95°F (0°C to 35°C) operating.
Humidity	0% to 95% RH max. at 20°C, non-condensing.
Size	10 in. high X 17.75 in. wide X 18.5 in. deep.
Weight	38 lb net.
Clearances	2 in. min. rear, 1/2 in. min. top, to allow cooling air to be drawn in the rear and exhausted through the top.

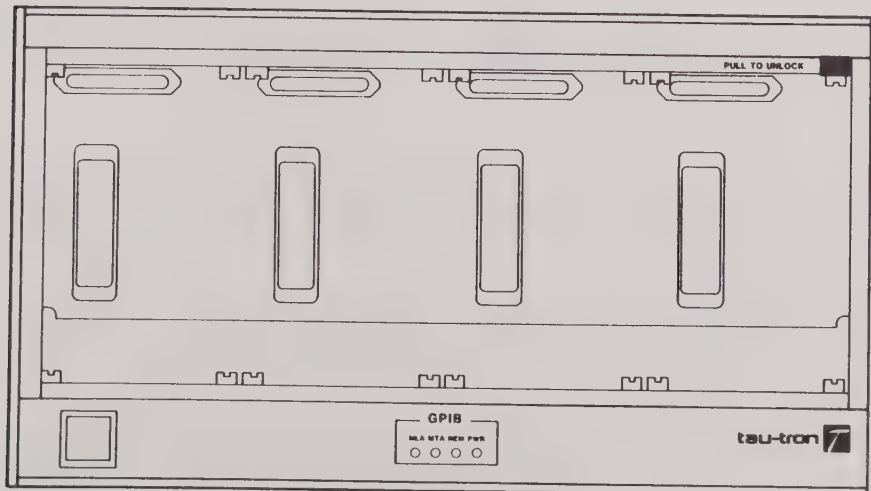


FIGURE 4-1. MF-5 MAINFRAME.

4.2 MODULE INSERTION

1. Pull out the mainframe Module Lock knob.
2. Insert the module as required.
3. Push in the Module Lock knob.

The MC-304 may be inserted in any position in the mainframe.

4.3 MODULE REMOVAL

1. Pull out the mainframe Module Lock knob.
2. Grasp the module to be removed by its front-panel BNC connectors and pull to remove.
3. Push in the Module Lock knob to prevent the remaining modules from accidentally falling out.

5. FRONT PANEL

1. RECOVERED CLOCK FREQUENCY SELECT Five thumbwheel switches with fixed decimal point. Switches are set to read the frequency the user desires to recover clock in; e.g., to recover clock at 44.736 MHz, the switches should read 044.73.
2. CODE SELECT Pushbutton (momentary) with associated LEDs, steps through the code formats to be decoded.
3. DATA/ECL OUTPUT BNC connector, drives a DC-coupled 50-ohm load, the termination voltage is -2V (ECL).
4. CLOCK/ECL OUTPUT BNC connector, drives a DC coupled 50-ohm load, the termination voltage is -2V (ECL).
5. DATA INPUT BNC connector with associated LED (not lit), input termination is 50 ohms-to-ground with ECL signal levels, or 1V into 50 ohms to -2V, LED (lit) as set by internal slide switch.
6. CLOCK INPUT BNC connector, with associated LED (not lit), input termination is 50 ohms-to-ground with ECL signal levels or 1V into 50 ohms to -2V, LED (lit) as set by internal slide switch.
7. RECOVERED/EXTERNAL CLOCK INPUT SELECT Illuminated pushbutton, selects either internally recovered clock from input data stream (pushbutton not lit), or an external clock (pushbutton lit) applied to the front-panel CLOCK INPUT BNC.
8. CLOCK/ $\overline{\text{CLOCK}}$ INPUT SELECT Illuminated pushbutton, selects either normal (pushbutton not lit) or inverted clock mode (pushbutton lit) of the user selected clock.
9. CLOCK/DATA PHASE INPUT SWITCH Four-position slide switch used to fine tune the input clock/data timing into the decoder.

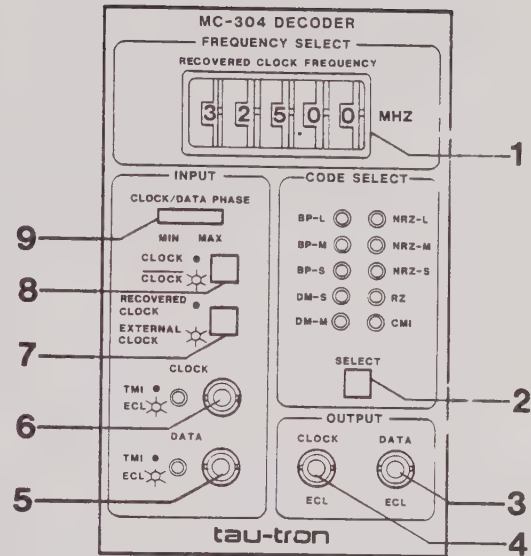


FIGURE 5-1. FRONT PANEL.

6. OPERATION

6.1 SYSTEM CONNECTIONS

A typical system interconnection diagram is shown on the following page.

6.1.1 INPUT TIMING SPECIFICATION

If the MC-304 is driven from a source other than an MC-303, or if there is some doubt as to the relationship between the MC-303 outputs, the input timing to the MC-304 should be set as follows:

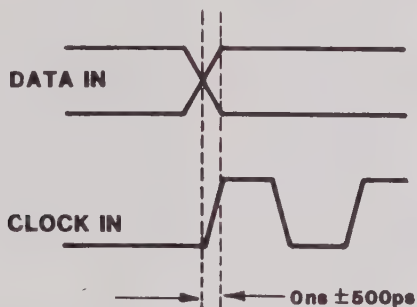


FIGURE 6-1, INPUT TIMING SPECIFICATION.

6.1.2 DATA AND CLOCK OUTPUT SELECT

A slide switch mounted internally on the printed circuit board selects the 1V or the ECL input level. The module must be removed from the mainframe in order to make the selection.

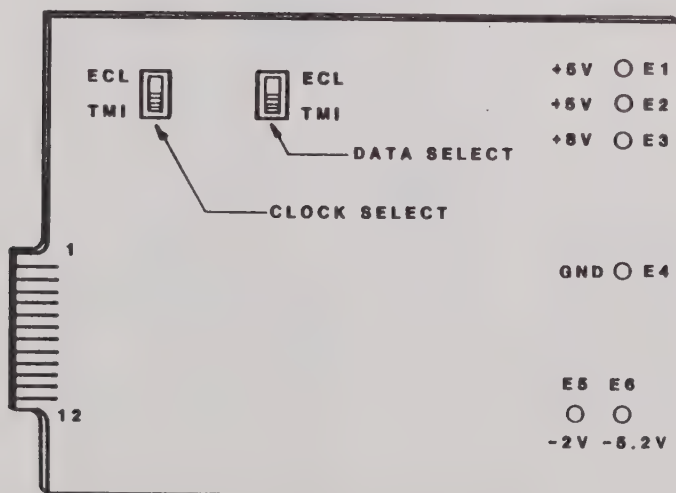


FIGURE 6-2, DATA AND CLOCK INPUT SELECT.

The diagram illustrates a comprehensive digital logic test setup. Key components and their functions include:

- MS-302 CLOCK SOURCE:** Provides a clock signal with frequency selection (1 to 10000 MHz) and range options (VCO, CRYSTAL, VCO VERNIER).
- MN-302 BERT TRANSMITTER:** Handles pattern selection, error injection, and data/output signals.
- MC-303 ENCODER:** Converts data into a format suitable for the system under test.
- MA-550 DUAL CHANNEL AMPLIFIER:** Amplifies signals for both Channel 1 and Channel 2, with adjustable amplitude and offset.
- MC-304 DECODER:** Receives signals from the system under test and decodes them, providing frequency select and input/output handling.
- MB-302 BERT RECEIVER:** Receives and processes data, including error frequency counting and mode selection.

The central **SYSTEM UNDER TEST** block is the core of the system, receiving data and clock signals and outputting data and clock signals back to the decoder. The diagram also shows various optional connections and signal paths, such as data out, clock recovery, and error signals.

6-2

6.1.3 Phase Switch Setting

When using the MC-304 outputs to drive an MB-302 receiver, set the MC-304 as required and set the PHASE Switch to the minimum position. With the MB-302 in the totalize mode and Auto Pattern/Sync Select, switch the MB-302 PHASE Switch through its ranges. If the System does not sync, select the next PHASE Switch position on the MC-304 and try the MB-302 PHASE Switch ranges again. Repeat this procedure until the MB-302 indicates an in sync condition with no error accumulation.

7. THEORY OF OPERATION

7.1 Description

The MC-304 accepts clock and any of 10 previously described binary coded formats and converts them to NRZ-L format at the output. The unit operates from 1 kHz to 285 MHz in NRZ and RZ and from 1 kHz to 145 MHz in all other codes.

7.2 Circuit Functions

7.2.1 Decoder

The input clock and data are fed to high-speed hybrid amplifiers for signal conditioning. The clock signals are then selected, via front-panel controls, to be either external or recovered clock. The selected clock is next Exclusive-OR'ed with the status of the front-panel CLOCK/CLOCK select control where it is distributed to the decoder logic and clock output amplifier.

The data are fed into a phase shifter which allows fine alignment of the clock and data at the decoder inputs. A high-speed one-shot circuit also differentiates each data edge into 1.5 ns wide pulses to be used in the wide-range clock recovery. After phase shifting, the data are distributed to the various decoder circuits. The front-panel CODE SELECT pushbutton steps a binary up counter which is used as a prom address. The prom outputs are level-shifted to ECL and used to enable the proper one-shot and decoder functions to decode the correct binary data format. The decoded data stream is then conditioned by another high-speed hybrid amplifier and is available at the front-panel DATA OUTPUT BNC.

7.2.2 Timing Recovery

The heart of the timing recovery is a wide-range voltage controlled oscillator (VCO). It covers frequencies from 1 MHz to 325 MHz through the use of an auto-ranging countdown circuit. The user selects an integer N on the front-panel thumbwheel switches to indicate the band (to within 0.1%). This causes the VCO frequency to be divided by 2N, and the result is compared with 5 kHz. A frequency-locked loop causes the compared frequencies to be equal, so the VCO frequency is (10 kHz) N.

Once the thumbwheel switches and the frequency-locked loop have brought the VCO frequency approximately to the band, a phase-locked loop brings it exactly to the band and locks the clock phase to the data phase. This is done by comparing the phase of the recovered clock with the phase of a processed data signal. When the phase is locked, an inhibit circuit disables the frequency comparator. (Refer to the block diagram on the following page.)

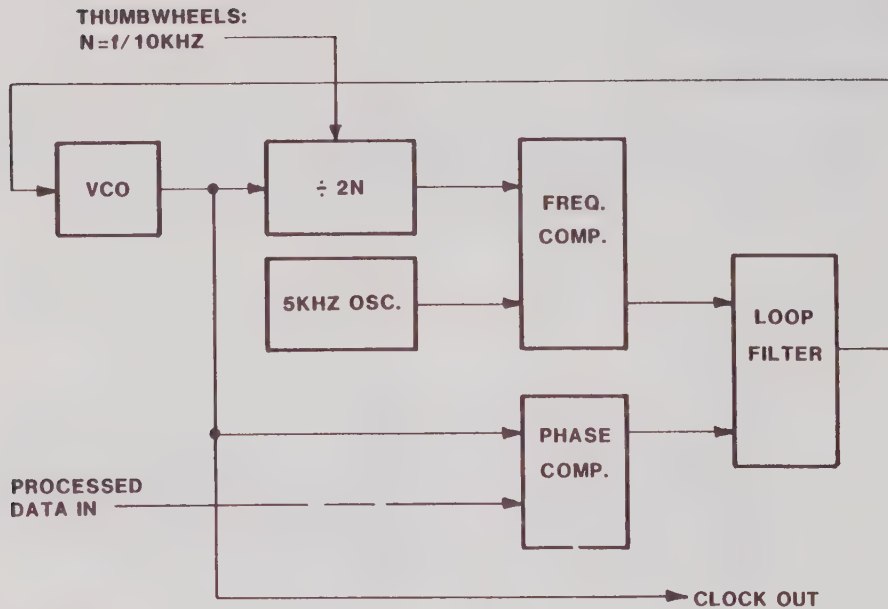


FIGURE 7-1. TIMING AND RECOVERY BLOCK DIAGRAM.

7.3 Module Power Supplies

The MC-304 develops its internal voltage from the +17V, -17V, +34V and -34V mainframe unregulated voltages. Three terminal regulators with boost transistors where necessary, on the module side and rear panels, generate +15V, -15V, +8V and -5.2V. On-card regulators develop +5V from the +8V input and -2V from the -5.2V regulator.

8. GPIB OPTION

General All front-panel controls except the FREQUENCY SELECT thumbwheels can be remotely controlled by a GPIB-compatible controller. The controller connects to the rear panel of the MF-5 mainframe. An associated address/control switch, also on the rear panel of the MF-5, must be properly set for the type of operation desired.

Message Format The message consists of five digits (in ASCII code) followed by a terminator.

Ident	SELECT 1	SELECT 2	CLK/ CLK	EXT/RCVD CLK	Termi- nator
-------	-------------	-------------	-------------	-----------------	-----------------

Ident	<u>Digit</u>	<u>Meaning</u>
	5 *	MC-304

SELECT 1	<u>Digit</u>	<u>Meaning</u>
	0	BiPhase-L
	1	BiPhase-M
	2	BiPhase-S
	3	DM-S
	0	DM-M
	1	NRZ-L
	2	NRZ-M
	3	NRZ-S
	0	RZ
	1	CMI

SELECT 2	<u>Digit</u>	<u>Meaning</u>
	0	BiPhase-L
	0	BiPhase-M
	0	BiPhase-S
	0	DM-S
	1	DM-M
	1	NRZ-L
	1	NRZ-S
	2	RZ
	2	CMI

CLK/ $\overline{\text{CLK}}$	<u>Digit</u>	<u>Meaning</u>
	0	$\overline{\text{CLOCK}}$
	4	CLOCK

EXT/RCVD CLK	<u>Digit</u>	<u>Meaning</u>
	0	EXTERNAL CLOCK INPUT
	1	RECOVERED CLOCK INPUT

Terminator Terminators recognized are comma, CR and LF. Alternatively, an EOI signal may be used as the message terminator.

* NOTE: If both the MC-303 and MC-304 are placed in the same MF-5, then the Ident digit for the MC-304 must be changed. It is suggested that Ident 6 be used. To do this, move the Berg jumper from position B to position A on the GPIB adapter board in the module.

9. SERVICE

DANGER

Hazardous voltages exist in this equipment. Do not attempt access to the interior without disconnecting the line cord from the power receptacle.

9.1 ROUTINE SERVICE

Routine service includes the performance of checks and service procedures which prevent or minimize the downtime of the unit. The checks and service are simplified, and may be limited to visual inspection for defective components, loose hardware, and /or accumulation of dust within the unit at critical areas.

NOTE: It is recommended that periodic cleaning (approximately once every three months) of the interior and exterior of the unit be done with a vacuum cleaner.

Refer to Section 4, Installation, for module removal.

9.2 REPAIR RETURNS

For mechanical damage or electrical malfunctions, refer to Page ii, Repair Returns.

9.3 ASSISTANCE

For service assistance call the Tau-tron Customer Service Dept., (617)256-9013. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

9.4 TROUBLE ANALYSIS

DANGER

Hazardous voltages exist in this equipment. Do not attempt access to the interior without first disconnecting the line cord from the power receptacle to the MF-5 Mainframe.

INPUT/OUTPUT LEVELS

Verify that proper input/output levels are correct. (Refer to Sections 3 and 6, Specifications and Operation, respectively.)

CALIBRATION

Routine calibration is not normally required except in the following situations.

- a. Failed component or circuit. Consult factory for further details.

b. Harsh environment; typical environment is:

Temperature 32°F to 45°F (0°C to 35°C)

Humidity 0% to 95% RH max. at 20°C, non-condensing.

Any calibrations or technical adjustments other than the situations mentioned above should not be made during the Warranty period unless otherwise authorized. Consult factory for further details. (Refer to Sections 3 and 6, Specifications and Operation, respectively, for proper outputs.)

10. DIAGRAMS

This section includes the following diagrams:

<u>FIGURE</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
10-1	MC-304 Decoder Block Diagram	10-2
10-2	Front-Panel Schematic Diagram	10-3
10-3	Decoder Schematic Diagram	10-4
10-4	Power Supply Schematic Diagram	10-5
10-5	Wiring Diagram	10-6
10-6	GPIB Personality Card Schematic Diagram	10-7

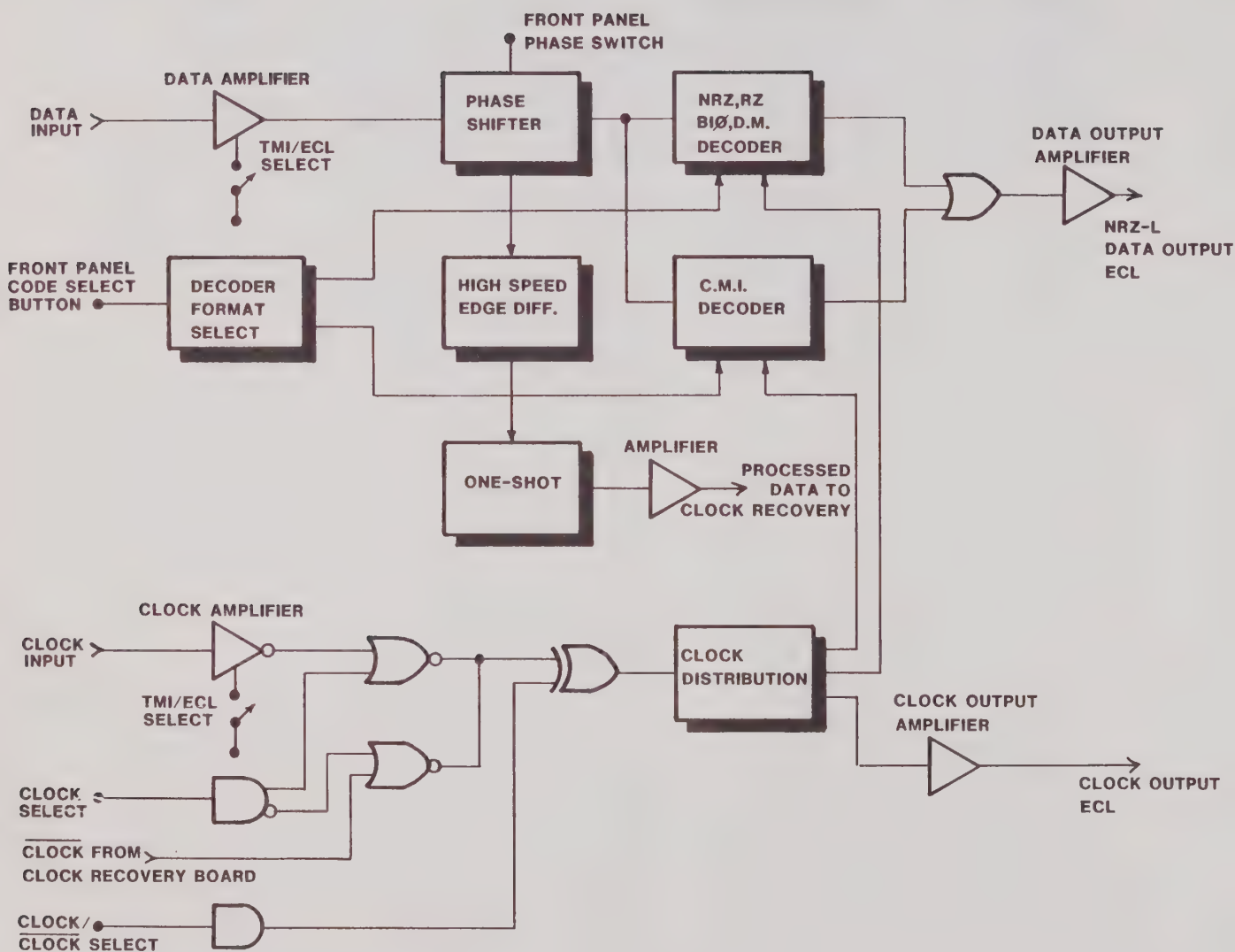
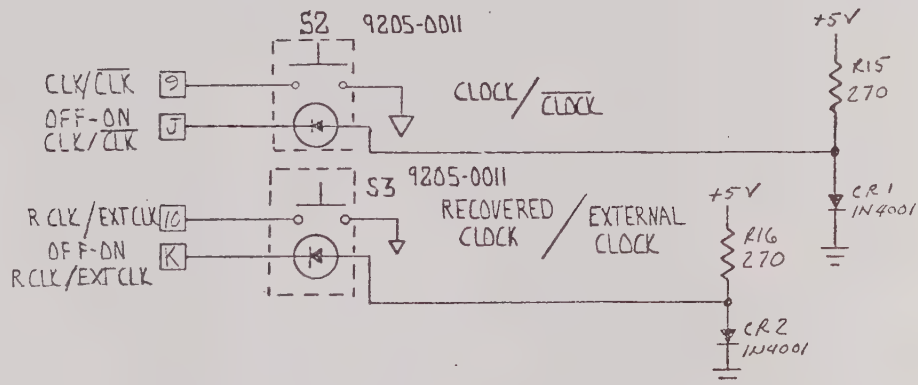
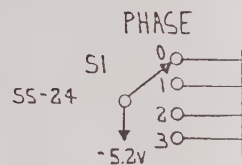
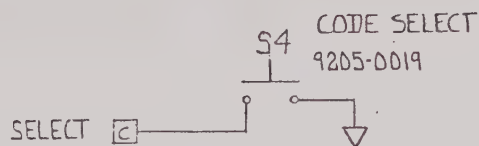
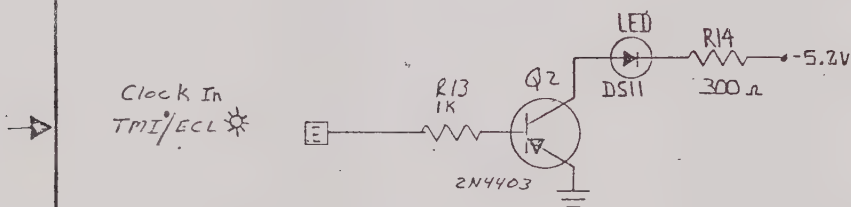


FIGURE 10-1. MC-304 DECODER BLOCK DIAGRAM.

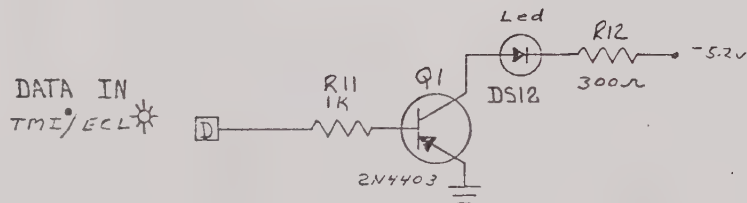
D



C



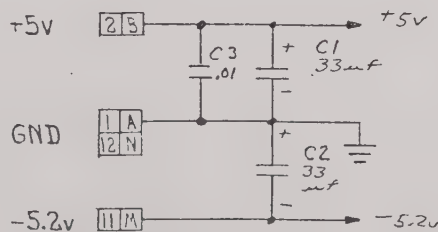
B



NOTES:

1. UNLESS OTHERWISE SPECIFIED
- A. RESISTANCE
- B. CAPACITANCE
2. ☐ DENOTES
3. ALL LEDS

A



WHERE APPLICABLE:
REMOVE ALL BURRS & BRUSH
SHARP EDGES TO 1/64.

C 54664 MC 309

NEXT ASSY USED ON

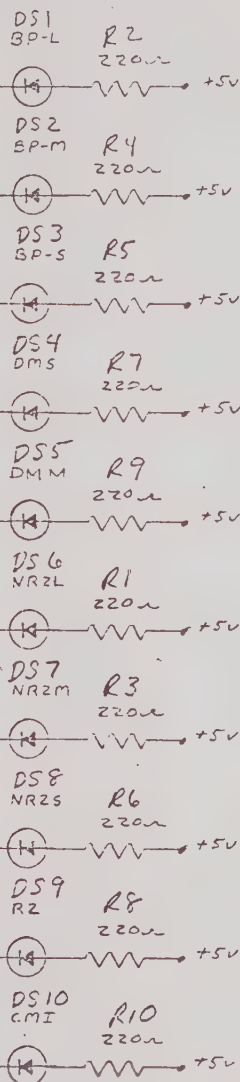
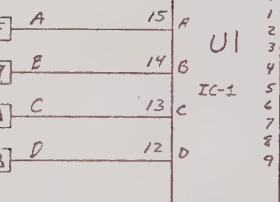
APPLICATION

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
2		UPDATED ORIGINAL	6-18-82	
3		ADDED R15, R16, C11 & C12	11-17-82	RL

PHASE

0
1
2
3

STATUS



UNLESS OTHERWISE SPECIFIED
VALUES ARE IN OHMS $\frac{1}{2}W \pm 5\%$
VALUES ARE IN MICROFARADS
DUAL 12 PIN CONNECTOR.
MV5374C.

Fig. 10-2
1 of 1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES $\pm$ FRACTIONS $\pm$ 3 PLACE DECIMALS $\pm$ 2 PLACE DECIMALS $\pm$ 1 PLACE DECIMALS $\pm$ MATERIAL:	CONTR. NO.		tau-tron inc	
	DR	SA	11-17-82	DRAWING TITLE SCHEMATIC FRONT PANEL
	CHK	RL	5-7-82	
	A P P D			
APPROVED	SIZE	CODE IDENT NO.	DRAWING NO.	REV
BY DIRECTION OF	C		C-54662	3
	SCALE	MC-304	SHEET 1 of 1	

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	LOCATED SUBSAL	5-1-72	306
	2	LOCATED PROTOTYPE	5-1-72	302

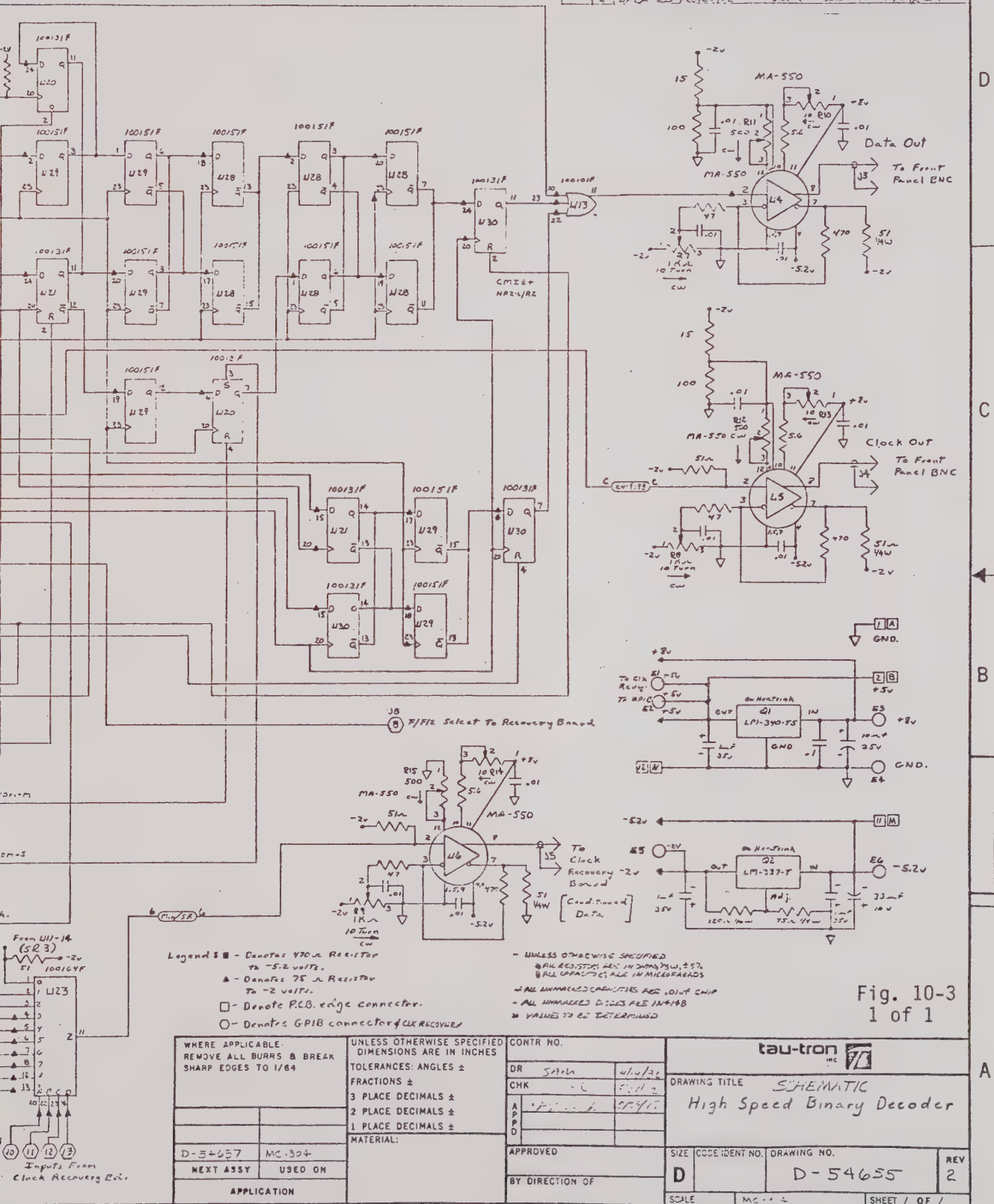
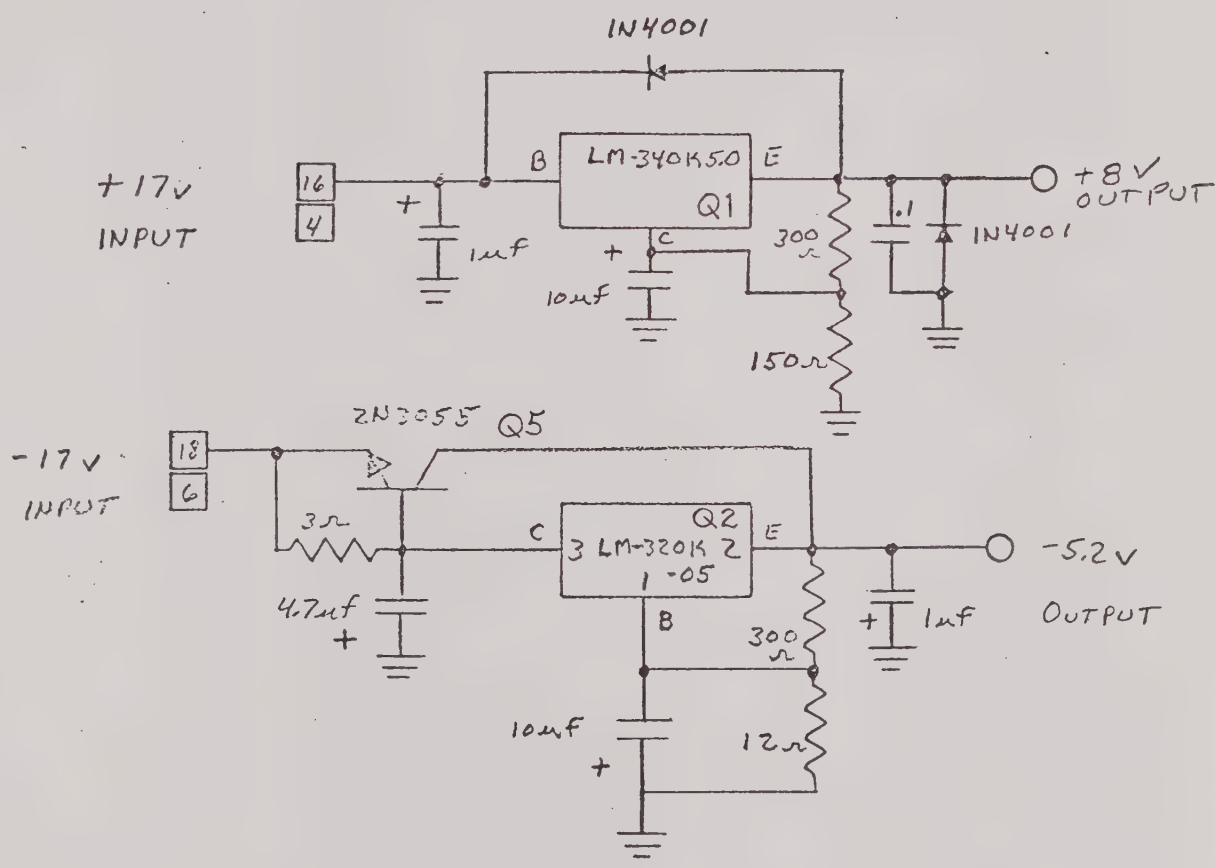


Fig. 10-3
1 of 1

WHERE APPLICABLE: REMOVE ALL BURRS & BREAK SHARP EDGES TO 1/64		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± FRACTIONS ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± 1 PLACE DECIMALS ± MATERIAL:		CONTR NO. DR <i>SMH</i> <i>4/14/80</i> CHK <i>LC</i> <i>5/1/81</i> APP'D <i>SMH</i> <i>5/1/81</i> APPROVED BY DIRECTION OF		tau-tron INC  DRAWING TITLE <i>SCHEMATIC</i> <i>High Speed Binary Decoder</i>				SIZE CODE IDENT NO. DRAWING NO. D <i>D-54655</i>		REV <i>2</i>	
D-54657 MC-304 NEXT ASSY USED ON						SCALE <i>MC-304</i>				SHEET / OF /			
APPLICATION													

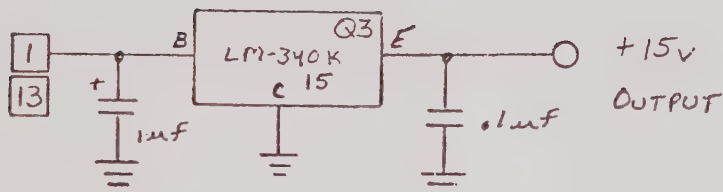


WHERE APPLICABLE:
REMOVE ALL BURRS & BREAK
SHARP EDGES TO 1/64.

NEXT ASSY	USED ON
APPLICATION	

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	UPDATED PROTOTYPE <i>ECO/CC979 JPP 29 JUL 81</i>	8-3-81	<i>1/4 PMP</i>
	A	ECO # 01024	9-25-81	AAM

+34V
INPUT



-34V
INPUT

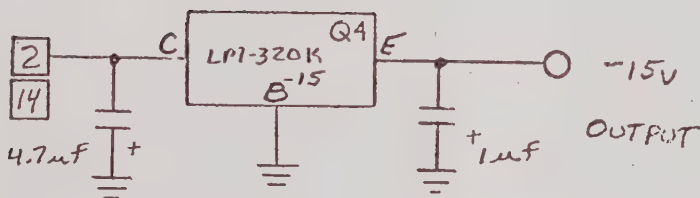


Fig. 10-4
1 of 1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± FRACTIONS ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± 1 PLACE DECIMALS ± MATERIAL:	CONTR NO.					
	DR	SAM				
	CHK		DRAWING TITLE			
	A					
APPROVED		SIZE	CODE IDENT NO.	DRAWING NO.	REV	
BY DIRECTION OF		B		TBJ-54511	A	
		SCALE	—		SHEET 1 OF 1	

8

7

6

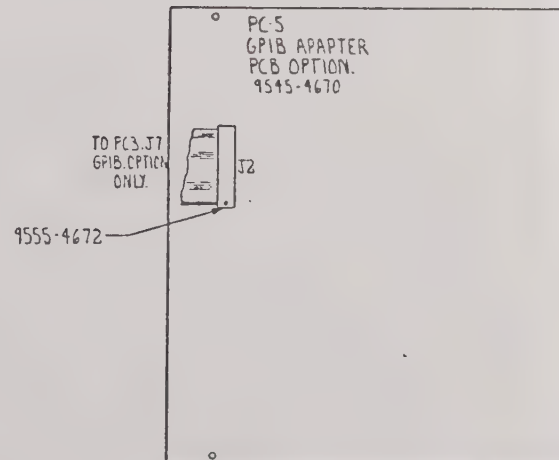
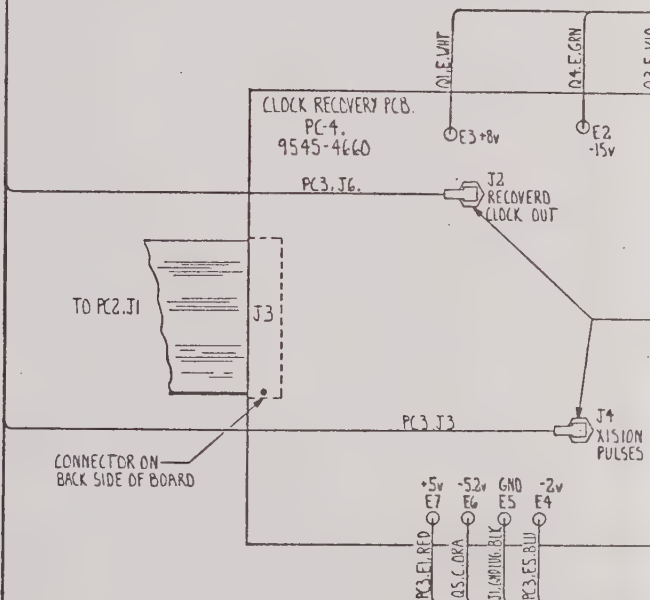
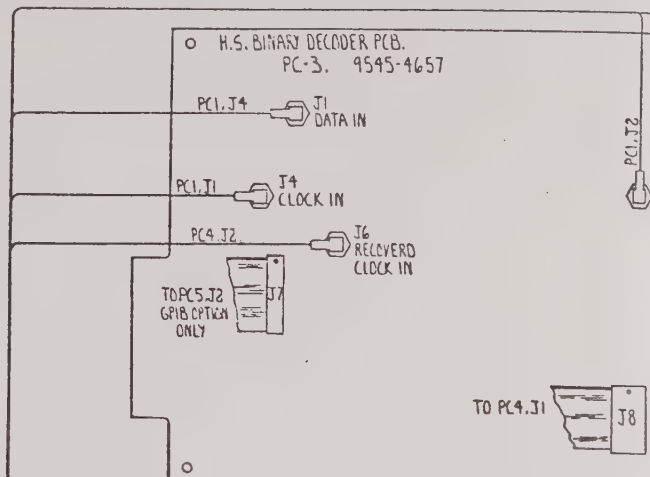
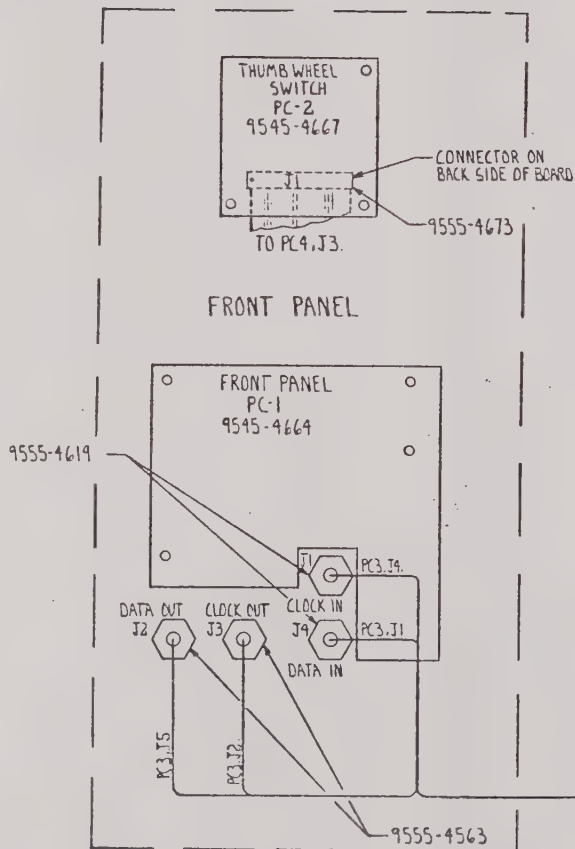
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D

C

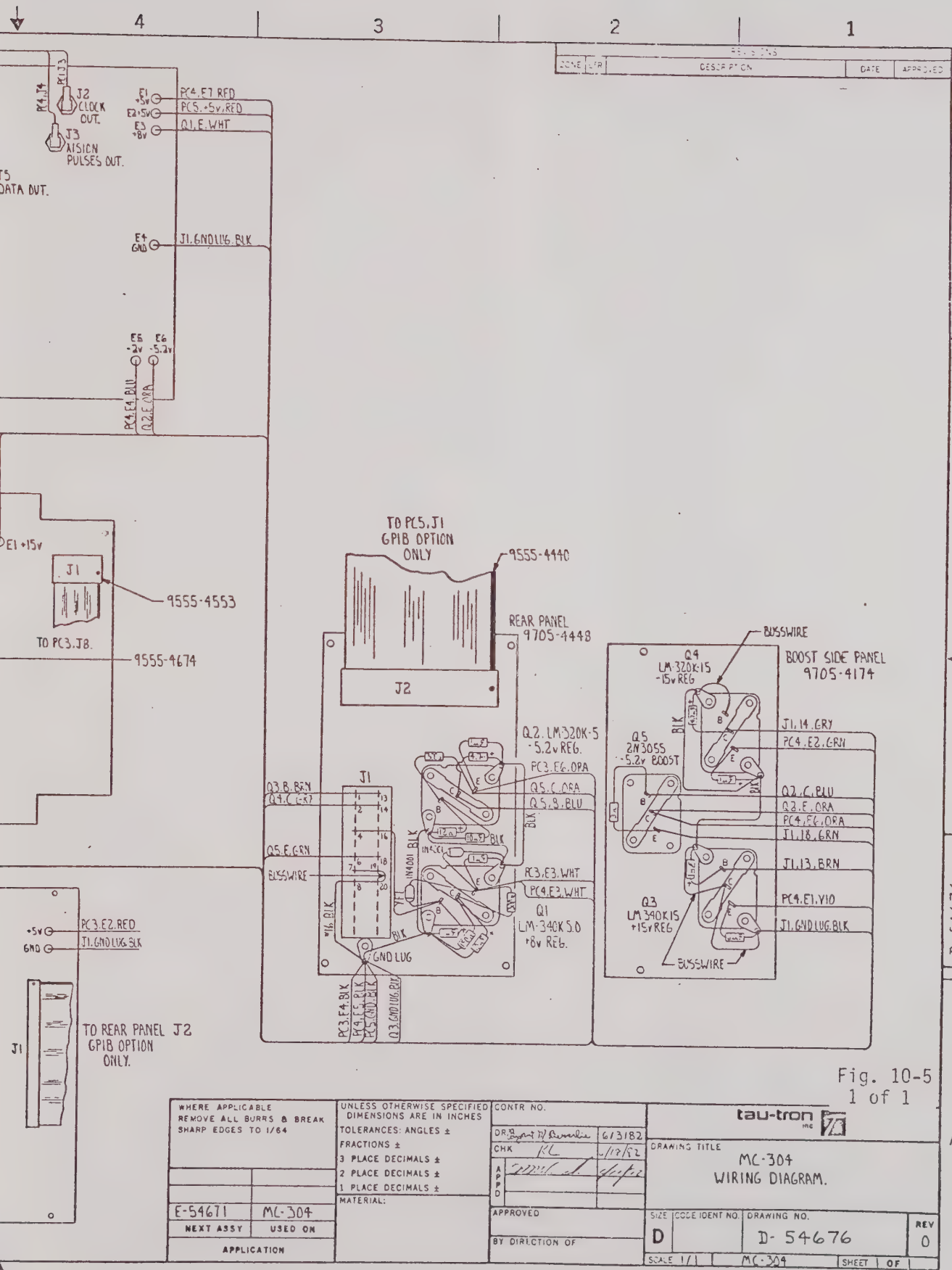
B

A



4. REFERENCE FINAL ASSEMBLY DWG #E-54671.
3. ALL COMPONENT LEADS OVER 1/8 IN. LONG MUST BE INSTALLED WITH CLEAR TUBING.
2. ALL WIRE TO BE #20 AWG.
AIR RESISTANCE VALUES ARE IN OHMS 1/4W ± 5%.
BICAPACITANCE VALUES ARE IN MICROFARADS.
1. UNLESS OTHERWISE SPECIFIED:

NOTES:



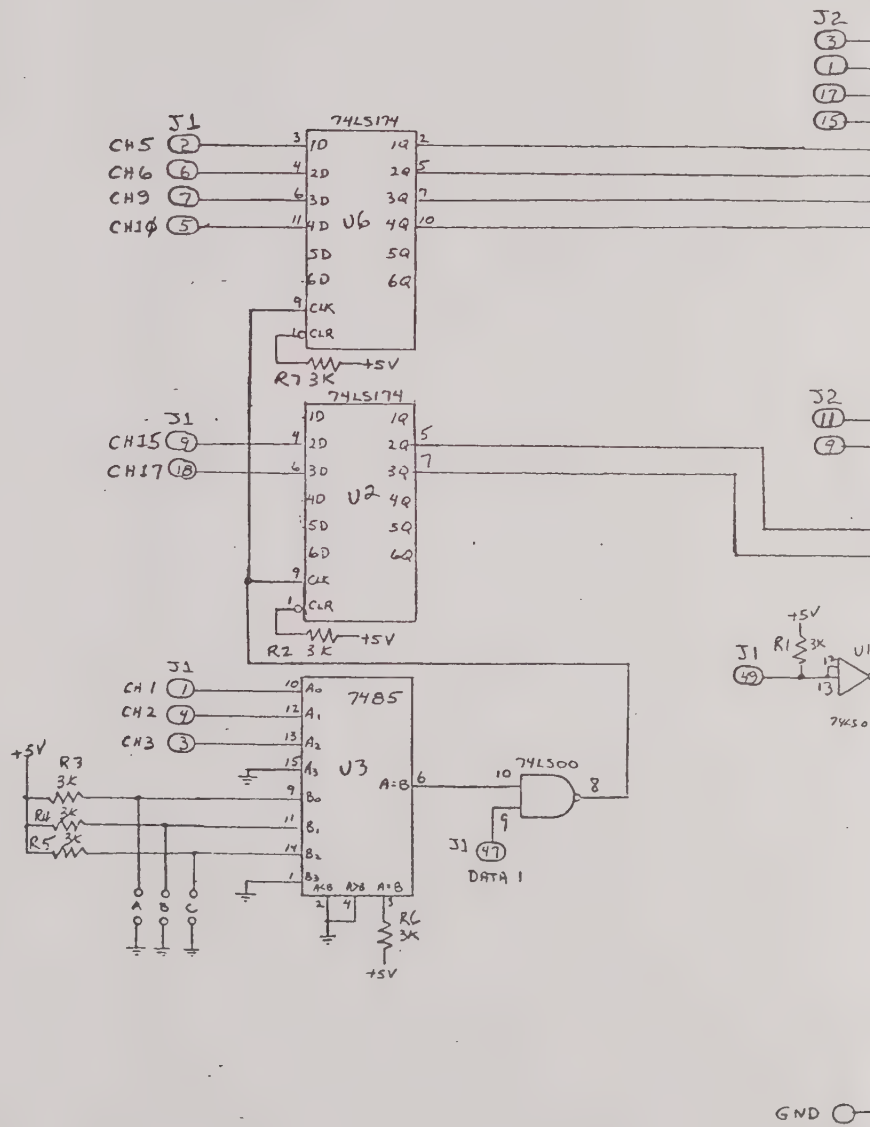
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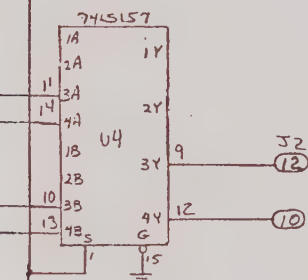
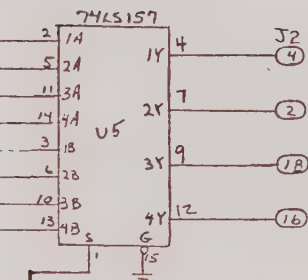
B

D-54676

A



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	J2-11 WAS J2-12 & J2-12 WAS J2-10	4/11/82	11/17/82



J1 = 50 Pin Connector

J2 = 20 Pin Connector

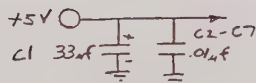


Fig. 10-6
1 of 1

WHERE APPLICABLE: REMOVE ALL BURRS & BREAK SHARP EDGES TO 1/64.		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTR NO.		tau-tron inc	
		TOLERANCES ANGLES ±		DRB. CASE 4/21/82		DRAWING TITLE GPIB PERSONALITY CARD.	
		FRACTIONS ±		CHK 4/21/82			
		3 PLACE DECIMALS ±		A B C 6/21/82		SIZE C	
		2 PLACE DECIMALS ±		APPROVED		CODE IDENT NO.	
		1 PLACE DECIMALS ±		BY DIRECTION OF		DRAWING NO. C-54668	
MATERIAL:						REV 1	
NEXT ASSY		USED ON				SCALE	
APPLICATION						MC-304 SHEET 1 OF 1	

C-54668

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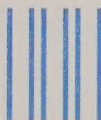
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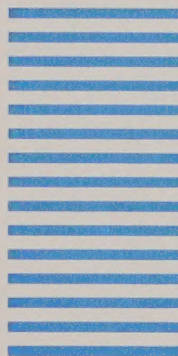
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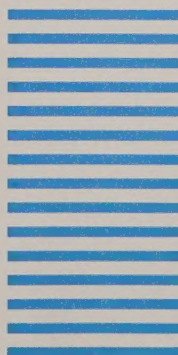
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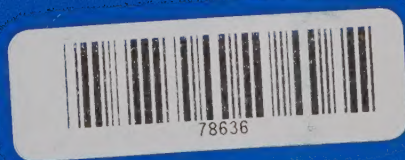
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